LOT #3 (B)

MT COOK & SOUTHERN LAKES TOURIST CO. LTD.

REMARKABLES SKI FIELD

ENVIRONMENTAL IMPACT AUDIT

COMMISSION FOR THE ENVIRONMENT

Commission for the Environment

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New Zealand

7 April 1976

The Director-General
Department of Lands & Survey
Private Bag
WELLINGTON.

Dear Sir,

REMARKABLES SKIFIELD

The Commission's environmental audit of the Mount Cook and Southern Lakes Tourist Company's impact report on the above proposal is attached.

The recommendations in the audit are for the consideration of the Land Settlement Board if and when the Board considers the proposal.

Yours faithfully,

W.J. Wendelken
Acting Commissioner.

Commission for the Environment

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Appendices

A. List of Submissions

B. Report on Construction Methods and Programme for Proposed Rastus Burn Access Road: Mr I. Stewart, Frederick Sheppard and Partners, Consulting Engineers.

C. Preliminary Engineering Geology Report: D. H. Bell.

D DSIR, New Zealand Geological Survey, Report on Sections of the Proposed Access Road.

7 April 1976

REMARKABLES SKIFIELD

ENVIRONMENTAL IMPACT AUDIT

1. INTRODUCTION

1.1 This audit follows the publication of an environmental impact report on the proposed Remarkables skifield and access road. The report was made publicly available on 20 December 1975 with an invitation to provide comments on the environmental aspects of the proposal by 9 February 1976. The Commission received 66 submissions. These are listed at the end of this audit and copies may be obtained from the Commission.

The proposal which is at a preliminary planning and design stage involves the phased construction of a 13 km access road and the development of skifield facilities in the Rastus Burn Valley of the Remarkables Mountains. The proposed development is on land held under pastoral lease from the Crown and in terms of the Land Act 1948 the Company must obtain a lease from the Land Settlement Board before development can proceed. It is in connection with this decision that the environmental impact report has been written and submitted for auditing. The audit was prepared by M. C. Holm.

1.2 Background

In June 1974 the Mount Cook and Southern Lakes Tourist Company Limited (the Company) made an application to the Land Settlement Board to develop the access road and skifield. The Board considered the application on 6 November 1974 and decided that:

> "the application be declined at this stage and that a broad-based investigation into the total Remarkables area be carried out to assess its potential for future scenic, recreation or tourist use."

Following this decision a planning brief for the Remarkables/Hector Mountains region was prepared and the Minister of Lands endorsed the establishment of a study group. The study group, convened by the Department of Lands and Survey and comprising representatives of Lands, the Ministry of Recreation and Sport and the Tourist and Publicity Department, has called for and considered public submissions. It has also undertaken field work and requested specialist studies from particular organisations, for example, the Otago Catchment Board.

The Land Settlement Board has an established policy on pastoral land required for development of skifields or similar recreational facilities. Prior to November 1974, when the policy was formalised, the Board authorised development of skifields on such areas by issuing a Special Lease in terms of Section 67 Land Act 1948 covering the skifield and ancillary equipment. The Treble Cone skifield near Lake Wanaka is being developed on pastoral land held under a Special Lease for a term of 5 years from 1 May 1971.

The Board has since decided that future cases involving establishments of this nature would be given a lease over the area required for building purposes only and would also be granted easements in terms of Section 60 of the Land Act 1948 authorising provision of access, ski tows and ancillary equipment. This policy ensures that members of the general public who wish to go to these areas but do not wish to avail themselves of any improvements are not excluded. In such cases as the Remarkables area, where development proposals are proposed on an existing Pastoral Lease, the Board could surrender the area out of the lease then offer the land for public application so all interested persons could apply. However, the Board also has the right to consider preferential allotment in terms of Section 54 of the Land Act 1948.

There has been no commitment whatsoever under Land Settlement Board policy that the proposed development would be warranted or that any lease would be issued for skifield development on the Remarkables or that the Company would be given preferential allotment, and it was on this basis that the environmental impact report was released for audit.

1.3 Other Statutory Procedures

The erection of buildings and other facilities will require the consent of the Lakes County Council under the Town and Country Planning Act 1953. At the present time the proposal is not a permitted use under the Queenstown/Wakatipu District Scheme and it will be necessary for the Company to make some form of planning application to the Lakes County Council. Any subsequent change to the District Scheme would be subject to rights of objection and appeal. The use of water and the disposal of effluent will require application to the Otago Regional Water Board for the necessary water rights under the Water and Soil Conservation Act 1967.

1.4 Role of Environmental Impact Report and Audit

The environmental impact report and audit will provide information on the environmental implications of the proposal for the Land Settlement Board.

This will be available, in conjunction with the study group's broad-based report on the Remarkables/ Hector Mountains region, when the Board considers the Company's application for a lease.

2.1 COMMISSION'S APPRAISAL OF THE E.I.R.

As an evaluation of the environmental implications of the Company's proposal the impact report is clearly inadequate. The report presents very little detailed information or evaluation of either the existing environment or the potential impacts of the proposed access road or skifield development. Nor does the report adequately identify or evaluate alternatives or safeguards which might avoid or modify the potential environmental impacts of the proposal.

In preparing the report at an early stage of planning the Company clearly expected the audit process to identify those environmental issues which warranted further investigations. In general, the Commission considers this to be a reasonable approach, but it should not lead, as with this report, to the preparation of a document which does little more than describe the proposed course of action and list a number of general safeguards.

Unsubstantiated generalisations occur in the report. For example, on Page 9 of the report under the heading 'Description of the Existing Environment' the following statement follows a general description of the location of the access road:

> "The project's influence on the environment will be limited in the terms of aesthetics, pollution, destruction of vegetation, alteration to topography and drainage."

A similar statement appears on Page 12 of the report under the heading 'Impact on the Environment':

> "It is not expected that the following facets of the environment will be affected to any significant degree: water or catchment, natural resources, the ecosystems in the area, any plant or animal species, areas or structures of historical or archaelogical importance, pollution problems, air quality, noise, etc."

Nowhere in the report is there presented any evaluation of basic data or information from which such wide conclusions might reasonably be drawn.

The following section discusses a number of issues which are not satisfactorily discussed in the report.

2.2 Visual Impact of the Road

The western face of the Remarkables Mountains is a spectacular and prominent landscape feature of the Queenstown area. The proposed road traverses the Kawarau River face at the northern end of this western face. It would be reasonable to expect the report to have made a careful evaluation of the visual impact of any section of the proposed road which might alter or affect the nature of the existing landscape. However, the report does not consider this aspect of the road in any detail, apart from stating (page 11):-

> "the road to the 4 mile 30 chain mark will appear as a thin line across the lower slopes of the northern shoulder of the Remarkables..."

This statement may or may not be an accurate prediction but little evidence of any kind is produced to support it. The Otago Catchment Board in Appendix E of the report suggests that from 3 miles 60 chains (6 km) to 4 miles 70 chains (7.9 km), a number of potential instability and erosion problems might arise along the proposed road route.

The report recognises the need for revegetation measures and a successful programme of re-establishment would considerably reduce the visual impact of the road.

2.3 Slope Stability and Erosion

The possibility of slumping or accelerated erosion in road construction is not discussed; nor are any specific road design or construction safeguards outlined. The Otago Catchment Board (Appendix E of the report) had clearly indicated to the Company the general nature of the potential instability and erosion problems but these issues are not discussed in any detail in the report. Where these matters are mentioned - for example, page 15 - they are presented in a form which indicates the Company's intentions and general awareness of its responsibilities,but not in a way which indicates awareness of any potential difficulties which may require detailed investigation and the adoption of

special design and construction methods. Similarly, more detail on the proposed revegetation programme is needed particularly on proposed revegetation methods and the control of grazing stock.

2.4 Impact of Skifield Facilities

The potential impacts of the construction and operation of skifield facilities within the Rastus Burn Basin are not clearly identified or evaluated in the report. In considering potentially adverse environmental effects, issues which need to be discussed in more detail include:

(1) Proposed methods of sewage disposal, rubbish removal and water supply.

(2) The need to move vehicles or bulldozers within the Rastus Burn Basin for construction and maintenance of lift facilities and/or the need for the creation or 'grooming' of ski trails or slopes.

(3) A clearer exposition of the ways in which buildings could be designed and constructed so as to blend, as far as possible, with the existing landscape.

(4) The potential capacity of the Rastus Burn Basin to provide for the anticipated long term skiing demand in the Queenstown area and the likely timing and method of expansion into the Doolan's Creek area.

2.5 Consideration of Alternatives

(a) Alternative Skifields

In order to meet its stated objectives the Company seeks a development area within 45 minutes travelling time (approximately 24 km) from Queenstown which is at sufficiently high altitude to eliminate (as far as is possible) the risk of lack of snow. In this context the following points are relevant:

(1) It seems likely from Appendix I of the report, prepared by Dr A. Mark, that the Rastus Burn Basin experiences harsh climatic conditions. In particular the likelihood of frequent winds and the prevalence of freeze-thaw days may have an effect not only on snow quality, but also on skiing conditions. This is not discussed in the report.

(2) No detailed evidence as to the reliability of snow or of its suitability for skiing is presented in the report.

(3) The report does not consider the potential capacity of other skifields - for example, Treble Cone near Wanaka - to absorb the growing demand for skiing facilities in the Southern Lakes region.

(4) The report does mention an alternative site in the vicinity of the Rastus Burn. The Doolan's Creek Basin adjacent to the Rastus Burn Basin is recognised as:

> "ideally suited for development and has the potential to cater for the long term requirements of a greatly increased number of skiers."

However, the Doolan's Creek area is discussed in the report as a future extension of the Rastus Burn Basin skifield, not as an alternative to it. The main reason for this appears to be the conclusion on page 4 of the report that "the only feasible means of access to this huge area is by chairlift from the Rastus Burn Valley."

Appendix A/1 to the report, prepared by the Company's consultant engineer, considers this question in more detail and concludes that the Coal Pit Road into the Doolan's Creek area is the only route that can be considered as an alternative to the proposed road. Although the Coal Pit Road alternative is considered to have "grave disadvantages", one obvious advantage is that it avoids the potential impact of a road across the Kawarau River face. For this reason the Coal Pit Road alternative and its disadvantages should have been discussed in more detail.

The Commission accepts that the provision of sightseeing facilities is one objective of development in the Rastus Burn Basin. Views obtainable from a ridge of the Remarkables could not be so readily provided by development in Doolan's Creek area. These matters, and the way in which the provision of sightseeing facilities limited the range of alternatives to the proposal, are not discussed in the report.

(b) Alternative Forms of Access to Rastus Burn

Of the two access options discussed in the report, road access is considered the only viable prospect. Mechanical access in the form of gondola lifts is eliminated on the grounds of cost and a number of other factors. (Page 5) Although the report concludes that the visual effect of the large tower supporting the chair-lift cables would be greater than the development of an access road, no further discussion of this aspect is made. The need to move up to 3,000-3,500 people per hour (Appendix O of the report) is not elaborated, except that the Company is clearly concerned about the safety aspects arising from the difficulties of evacuating people quickly (in the event of some emergency) solely by mechanical means.

2.6 Recreation

The report does not evaluate the effect of skifield development and facilities on current or possible future recreational uses of the Rastus Burn Basin and other adjacent areas e.g. the ridges of the Remarkables and the Upper Wye Creek, except to conclude (page 10) that: "at present there is very little human use other than some tramping and climbing in the area."

Although the provision of both skiing and tourist sightseeing activities are objectives of the proposal, the facilities required and the associated increase in the number of visitors will substantially alter the nature of the area for trampers or climbers who value the Rastus Burn Basin in its unmodified state. No recognition or evaluation of this potential loss is made in the report, nor are any safeguards discussed which might keep landscape disturbances to a minimum.

Another aspect of recreational usage not discussed in the report is the likely increase in the number of trampers, climbers and other visitors created by the existence of a road into the area. Increasing numbers of people would have the potential to eventually diminish the recreational appeal of the area for some users. In popular or vulnerable areas the risks of long term damage to vegetation (e.g. trampling, fires) are also increased. These aspects, although not covered in the impact report, will be considered by the study group (see page 1, 1.2)

2.7 Effect on Community and Land Use

The report lists a number of beneficial social effects to the Queenstown district and community. No attempt is made to outline potential increases in pressures on existing services (such as water supply, roading, sewage treatment facilities and hospital services). Potential increases, such as the demand for private residential subdivisions in the Queenstown district are not discussed. These matters are the concern of local authorities in the area - in particular the Lakes County Council from whom planning permission for the proposal will be required. These aspects will be considered in the context of the Queenstown/Wakatipu District planning scheme and its current review.

3. SUMMARY OF PUBLIC SUBMISSIONS

Of the 70 submissions received most expressed concern at some aspect of the proposed development as outlined in the impact report.

A group of some 30 submissions, mainly from private individuals, expressed opposition to any form of commercial development in the Rastus Burn Basin or any other area of the Remarkables. Many of these submissions, which included a petition containing some 300 signatures, requested some form of special reserve status for the area to prevent any future development.

A second major group of submissions received from private individuals, environmental organisations and Government departments were critical of the nature and content of the environmental impact report prepared by the Company. Many considered it misleading and lacking in basic information essential to an adequate appraisal of the environmental impacts of the proposal. The submission from the Otago Tramping and Mountaineering Club illustrates the general nature of comment received from organisations concerned with recreation or environmental protection:

> "Inadequate definition of the physical extent of the proposed development and lack of information on the existing environment make difficult any valid assessment of environmental impact either by the authors of the report or by the reader. The authors therefore give unqualified dismissals of potentially adverse effects of the proposed development. They have not given evidence that they are fully aware of all possible adverse effects nor have they

> given adequate assurances they will be able to minimise environmental disturbance when and where it does occur."

The Remarkables Protection Committee in a detailed critique of the impact report concluded:-

> "The report on the project is presented in the form of public promotive material, whereas it should be confined to a clear and detailed statement of the project, embodying a frank and impartial presentation of the environmental impact of that project."

Submissions received from several Government departments also contained criticism of the lack of information in the report. For example, the DSIR submission stated that:-

> "Further information on glacial features, land stability, snow depths, vegetation, alternative road routes, ski-tower sites, road and pylon construction, buildings, car parks and sewage disposal is required before the various impacts on the environment can be evaluated."

A number of submissions suggested that the Company had not adequately examined the possible alternatives to the proposal outlined in the report. In such submissions it was argued that the Rastus Burn Basin had very little potential as a skifield in comparison to the adjacent Doolan's Creek which, it was argued, could be developed by constructing an access road over Coal Pit Saddle into the Doolan's Creek area. In support of this argument several organisations and individuals associated with tramping, mountaineering and skiing suggested that the Upper Rastus Burn Basin, particularly Lake Alta and the ridges and peaks of the Remarkables, was an area of considerable potential for other forms of recreation free from any development, e.g. for tramping, climbing, ski-touring and camping. On the question of alternatives to the proposal, the Otago Mountaineering and Tramping Club concluded a detailed submission by stating:-

> "Restricting skifield development to the Upper Doolan's Creek Valley is a satisfactory way to develop the recreational potential of the Remarkables area without excessive detriment to the scenic attributes or current recreational activities."

Other submissions put forward the view that the need for a new skifield had not been established. For example, the Federated Mountain Clubs' submission stated:-

> "The argument that 'failure to provide the additional skiing resources will make it more difficult for New Zealanders to share in a sport of increasing popularity' ignores the recently developed skifield at Mt. Hutt and the proposed skifield at Treble Cone in the Wanaka area..."

The potential of the Rastus Burn Basin as a skifield was questioned in a number of submissions. Mr D.G. Jardine of the Remarkables Station put forward the view that:-

> "The actual skiable days will be considerably below that of Coronet Peak because of the increased incidence of storm and reduced visibility due to cloud which Coronet Peak just escapes due to its lower altitude."

Other submissions pointed out that the Company had not presented any data as to the reliability or quality of snow in the Basin. The Otago Tramping and Mountaineering Club considered that a number of factors cast doubts on the merits of the Rastus Burn Basin as a skifield. These included the northerly aspect of the Basin, the severe climate and the reliability of snow. Part of this submission concludes by stating:-

> "...we do not deny that there is skiable snow in the Rastus Burn basins and that it may remain slightly longer than at Coronet Peak. But the actual number of days in which good snow and weather conditions combine for favourable skiing are likely to be very limited. Further investigations need to be made prior to the commencement of any of the proposed development."

On the other hand, both the New Zealand Ski Association and the New Zealand National Ski Team Coach, Mr R. Sargent, provided submissions to the Company which indicated the Basin had considerable potential for skifield development. (Appendices L and N of the report).

Several local residents were concerned that the effects of the skifield on the Queenstown community itself had not been adequately assessed in the impact report.

In most of the more comprehensive submissions the criticisms of the nature and content of the impact report were developed into detailed criticisms of aspects of the proposal itself.

The Ministry of Works and Development provided comment on a variety of issues associated with the proposal including water supply, sewage disposal and planning matters. Detailed comment on the engineering/

geological problems associated with the proposed road line raised serious doubts about the engineering feasibility of a section of road and also outlined other potentially serious erosion problems, all of which could lead to the access road having a significant visual impact, particularly where it crosses the Kawarau River face on the Remarkables. The submission included the following comments:-

> "The proposed access road passes through extremely unstable country from 2 miles 50 chains to approx. 4 miles. This is in fact the same area that will be most visible to the Frankton/Shotover/Arrowtown locality...
>
> "The instability of the face is such that unmistakeable signs of large earth movements in the past are clearly visible from the State Highway 2 or 3 miles distant...
>
> "On the ground fresh fissuring was observed indicating that ground movement is now taking place even under natural conditions. The degree of slope and material is such that any movements started by disturbance of the country would almost certainly be large ones...
>
> "The difficulty is not merely one of surface solifluction materials but also one of underlying unstable weathered schists. A solid foundation appears available for maybe one third of the length only. There is little doubt that any road or track across this face would start large earth movements both above and below the road."

The DSIR confirmed that a number of potential geological hazards to the construction of the proposed access road existed and made a number of detailed recommendations for road and pylon construction on unstable areas.

The Otago Catchment Board provided a detailed submission on aspects of the access road and skifield development including the potential instability and erosion problems and the difficulties associated with revegetation of disturbed surfaces. The Board also supported the MWD view that the feasibility of alternative access over Coal Pit Saddle should be investigated.

The Nature Conservation Council, the New Zealand Scenery Preservation Society, and a number of other submissions expressed specific concern for the potential visual impact of the access road. The Council made the following comment:

> "the full Nature Conservation Council has now seen the area of the Remarkables which would be affected by the road to the proposed skifield, and Council's view is that since there is room for doubt about the acceptability of a road and since reasonable alternatives may exist the project should not proceed."

The New Zealand Geological Society made the following comment on the visual impact of the road:

> "roading would appear to be the main source of pollution (visual) and the Company seems to be aware of this problem and has planned accordingly"

The Protection Forestry Division of the Forest Research Institute considered that the impact report showed that the Mt. Cook Company was aware of its responsibilities in relation to environmental protection and was prepared to take action to mitigate the effects of its development programme on the landscape. However, on the question of revegetation, the Division pointed out that the Company may have underestimated the practical difficulties involved.

The Federated Farmers (Otago Branch) had no objection to the proposal "providing the runholders concerned have their rights protected."

Finally, one letter from Mr W. Harris expressed strong support for the establishment of a skifield in the Remarkables.

4. COMMISSION'S APPRAISAL OF THE PROPOSAL

The Remarkables/Hector Mountains region has considerable potential for a variety of recreational uses. Much of the higher altitude land has been retired, or is likely to be considered for retirement from pastoral uses in order to promote water and soil conservation objectives.

Development proposals on such high country land must be assessed in the light of other potential recreational uses as well as any physical constraints to development which the nature of the land may impose. Neither of these factors has been adequately evaluated in the impact report but at this early stage of planning this does not necessarily mean the proposal should be rejected as unsound on environmental grounds.

Subject to one major reservation concerning the proposed access road, it is possible to reduce or avoid the major environmental impacts of the proposal by adopting high standards of design, construction, maintenance and skifield management. The Commission considers that these high standards can best be achieved within the framework of a comprehensive roading and skifield development plan prepared and approved before any road construction or other development activity begins.

The reservation mentioned above concerns the construction and maintenance and associated visual impacts of sections of the proposed access road.

The wider question of the need for further alpine tourist and/or skifield facilities in the Queenstown area and the inherent suitability of the Rastus Burn to provide them is one of the matters that will come before the Land Settlement Board. Similarly, the resolution of potential conflicts between the proposal and other recreational or conservation uses is also a matter for the Board. As indicated earlier, a study group is currently carrying out investigations to assess the potential of the region for future scientific, recreational and tourist use. The final recommendations of this study group will identify, amongst other things, those areas with potential for tourist and skifield development as well as other recreational and conservation uses.

Although comment in the impact report (Appendix N) from the New Zealand Ski Association suggests that the Rastus Burn Basin has intrinsic merit as a skifield, other submissions have expressed doubts about this, and in the absence of any systematically

collected data as to snow conditions or climatic factors, it is not possible to make a scientific evaluation of the Rastus Burn Basin's potential as a skifield. From the point of view of tourist sightseeing, the proposal would provide access to a commanding vantage point on a ridge of the Remarkables Mountains. At this high altitude adverse weather conditions might restrict the use of this facility for sightseeing and the frequency of any such disruption should be considered.

The Commission's appraisal of the proposal is confined to those environmental safeguards it considers should be adopted if the proposal is to proceed. It is recognised that any final decision by the Land Settlement Board would consider the wider issues outlined above on which little information is currently available.

Stability and Visual Impact of Access Road

The western face of the Remarkables Mountains is a world renowned landscape feature. A thin road line crossing the lower northern end of this outstanding series of mountain peaks would, in the Commission's view, not constitute a significant visual impact. However, it seems a distinct possibility that a considerable length of the proposed road between 2 miles 50 ch (4 km) and 4 miles 70 ch (7.9 km) would appear as far more than a thin line.

The degree of visual impact in this area is closely related to the steepness of the terrain, geological instability and the high susceptibility of the area to erosion. Particular problems include:-

(a) The instability of bedrock and landslide materials in which the road is to be formed.

(b) The creation of high side batters and difficulties associated with stabilising these.

(c) The difficulty of retaining side spill on the steep hill slopes and stabilising downslope batters.

(d) The construction and efficient operation of drains, cut-offs and culverts that would carry run-off without causing or accelerating erosion.

(e) The stabilisation and revegetation of exposed soil surfaces on a road that is progressively widened and upgraded.

(f) Disposal of rock removed from deep cuttings and the control of side casting.

(g) Exclusion of stock and other animals (e.g. hares) from new plantings established for stabilisation purposes.

In view of these potential problems associated with the access road and the lack of consideration given to potential difficulties in the impact report, the Commission gave the Company the opportunity of providing further information on the critical sections of the access road. This was received on 18 March in the form of two reports (Appendices B & C to the audit). The Commission also requested the New Zealand Geological Survey of the DSIR to provide the Commission with a report on the engineering/ geological aspects of this section of the road. This was received on 30 March (see Appendix D to the audit).

The Commission realises that those who made submissions on the Company's impact report have had no opportunity to make further submissions on the more detailed information provided by the Company. However, the Commission considered it essential to its own evaluation of the proposed road that the potential problems raised by MWD, DSIR and Otago Catchment Board be further explored.

The Company, on the basis of its own investigations, has now modified its roading proposal particularly where it crosses the Kawarau River face. This includes the narrowing of the road to a single one-way formation in difficult sections. (See Appendix B to this audit.) Whether or not these subsequent modifications will be adequate to prevent significant visual impacts across the Kawarau River face and in any other difficult sections, is largely a matter of balancing expert opinions. On the available evidence it seems that road construction in certain areas will involve considerable risk of slope disturbances and erosion over an area much wider than the road line itself. These potential risks warrant more detailed investigation of the feasibility of alternative road access over Coal Pit Saddle into the Doolan's Creek area.

The Commission also considers that considerably more geological and engineering investigations and careful design of the proposed road route by the Company is essential. In particular, attention should be given to :-

(a) The use of one way road sections of narrow formation widths to avoid major earthworks in difficult sections.

(b) The use of devices such as crib walling, sheet-piling and half-bridging to avoid side spill where major instability problems arise and/or limitation in the height of cut batters is necessary.

(c) The selection of safe and efficient methods of disposal of run-off from the road which do not cause or accelerate erosion.

(d) The restoration and rehabilitation of disturbed surfaces including the topdressing of cut and fill batters and any other disturbed soil surfaces with fertilizer and seed to the requirements of the Otago Catchment Board. Expert advice on revegetation at higher altitudes should also be obtained from the Protection Forestry Division of F.R.I.

(e) The selection of suitable disposal points for rock and spoil where stabilisation can be facilitated and visual impact reduced.

(f) The construction of any road to be as close to final grade and standard as possible to avoid the need to progressively upgrade the road.

This detailed planning of the road, including the matters outlined above, should form Stage I of a comprehensive development plan, prepared for the whole proposal, which is discussed below.

Comprehensive Development Plan

Any prior approval of the Company's proposal should be conditional on the preparation of a comprehensive road and skifield development plan. This plan should incorporate detailed environmental safeguards and be approved by the Land Settlement Board before any construction works commence. It should cover the total development of the access road and skifield facilities in the Rastus Burn and Doolan's Creek area.

(a) Road

As discussed above, the first stage of the development plan should deal with detailed geological and engineering aspects of the access road and outline the design and construction safeguards proposed. Road design, construction, a revegetation programme and

maintenance standards should be developed in consultation with the Otago Catchment Board whose final approval of the road standards and specifications should be obtained. As part of the overall investigations the feasibility of alternative road access over Coal Pit Saddle into the Doolan's Creek area should be examined.

(b) Skifield Facilities and Management

The second stage of the plan should outline, in far more detail than the impact report, the development and management proposals for the Rastus Burn Basin. This would involve consideration of the need for and likely timing of any expansion of facilities into the Doolan's Creek area. The alternative of development solely in the Doolan's Creek area should be assessed as part of this planning, as well as any eventual long term need for road access to the Doolan's Creek area. As far as development of the Rastus Burn Basin is concerned, the Commission considers that the following essential safeguards should be incorporated into the development plan:-

i) Location and design of all proposed buildings to be approved by the Department of Lands & Survey. Buildings should be designed and built to blend in with the natural surroundings of the Rastus Burn Basin. This should include making external use of stone and other appropriate materials.

ii) Provision of water supply, toilet and sewage disposal facilities of a high standard. The sub-soil near the central ski facilities should be carefully investigated for its suitability for septic tank disposal and construction of pit privies. If conditions prove unsuitable for these forms of disposal, consideration should be given to the installation of a sewerage and sewage treatment system (either on or off site). Although water rights for sewage and effluent disposal will be required from the Otago Regional Water Board, it is the Commission's view that the Company should take the initiative and provide facilities, from the outset of the development, for sewage treatment and disposal to a high standard. The Commission accepts the MWD view that septic tanks and drainage filters alone will be inadequate to meet the long term requirements of the development. Plans for rubbish collection and disposal should be

further developed along the lines outlined in the impact report (page 15,iv).

iii) In planning the line and location of ski lift facilities the Company should consult with the Otago Catchment Board. Sites for pylons or towers should be chosen after appropriate geological investigations. The Commission considers that the construction of roads or tracks for lift construction and maintenance purposes should be avoided wherever possible. Only one carefully sited access track up each chairlift line should be constructed and lateral access roads to individual towers should not be considered. The use of helicopters for the installation and servicing of lifts should be investigated. The location and construction of any tracks or roads within the Rastus Burn Basin should be approved by the Department of Lands and Survey and the routes where soil and vegetation has been disturbed (as well as exposed batters and hillslopes) should be oversown with seed and planted in tussocks to the satisfaction of the Otago Catchment Board. Successful revegetation above 1500m may prove difficult but it should be planned and carried out as an integral part of a continuing revegetation programme for the whole development.

iv) No cutting of tussocks, removal of rocks or bulldozing of slopes for slope "grooming" purposes should be allowed except with the express approval of the Otago Catchment Board. In summer, alpine cushion, herbfield and bog areas within the Rastus Burn Basin would be extremely vulnerable to the passage of any form of vehicle and such areas should be avoided. Planning of the development should aim to identify vulnerable areas within the Basin and lead to the adoption of appropriate precautions. For example, concentrated use of snow track vehicles could compact snow over vulnerable areas and cause damage. Similarly, the location of run outs and lift queue areas at the bottom of ski slopes should be planned, wherever possible, to avoid damage to vegetation when snow is thin or has been worn away.

v) The provision of facilities within the Rastus Burn Basin is likely to encourage increasing numbers of people to use the Basin and adjacent areas in summertime. The dangers of a summer fire are

considerable and at this altitude would have severe long term effects. The consistent trampling of vegetation in popular or especially vulnerable areas, e.g. alpine bog and herbfield areas, should be avoided by appropriate siting of walking tracks.

It is the Commission's view that the Department of Lands and Survey in co-operation with the Otago Catchment Board should initiate a vegetation condition and trend study to monitor the effects of use both in winter and summer. From such studies appropriate management policies could be formulated. Such a study beginning at the outset of development, could provide useful information not currently available in New Zealand. Designated campsites, walking tracks and picnic sites should be provided by the Department of Lands and Survey in co-operation with the Company. The Department of Lands and Survey and the Company should discuss arrangements for the appointment of a ranger(as outlined in the impact report, page 15) with supervisory responsibilities and appropriate powers.

vi) The provision of a lift enabling access by track to a ridge of the Remarkables must not lead to the establishment of any form of shelter or "look-out" structure which sits above the sky line or is in any way visible on the front (or western) face of the Remarkables.

5. CONCLUSIONS

(1) The potential environmental consequences of the Company's proposal have not been adequately identified in the Company's environmental impact report.

(2) The major environmental consequence of the proposal is the potentially adverse visual impact of sections of the access road, in particular where it crosses the Kawarau River face. The potential instability and erosion associated with sections of the road not only pose problems for road construction itself but also substantially reduce the likelihood of the road appearing as a "thin line".

(3) Should detailed geological and engineering investigations indicate that a road across the Kawarau River face is feasible, the planning and design of any road should incorporate detailed design and construction safeguards. These safeguards should be aimed at reducing the visual impact of the access road and ensuring the long term stability of the road and adjacent mountain slopes.

(4) The potential instability and visual impacts of sections of the proposed access road warrant the further investigation of the feasibility of an alternative road access over Coal Pit Saddle.

(5) The development of alpine tourist and skifield facilities in the Rastus Burn Basin while providing a valuable recreational amenity for winter and summer use, also has the potential to detrimentally affect the natural qualities of the area. The success of the development itself depends on how successfully these qualities are maintained in the planning and development of the proposal.

(6) The Company should prepare a detailed and comprehensive plan of the overall development which incorporates appropriate environmental safeguards (as outlined on pages 16-19 of this audit) for the final approval of the Land Settlement Board. To undertake detailed planning of the skifield the Company would require road access to the Basin but an overall concept plan of development should still be prepared before any road construction is commenced.

6. RECOMMENDATIONS

The recommendations of the Commission for the Environment are as follows :

(1) Because important aspects of the proposal require further investigation of possible alternatives and the detailed planning of appropriate environmental safeguards, the proposal should not proceed in the form described in the environmental impact report.

(2) When the proposal comes before the Land Settlement Board again, the Commission recommends that the Land Settlement Board include consideration of the following matters in any decision :

(a) The overall need for further alpine tourist and skifield facilities on Crown Land within the Southern Lakes region.

(b) The intrinsic suitability of the Rastus Burn Basin for development as a skifield.

(c) Other potential recreational uses and water and soil conservation requirements in the area.

(d) Any potentially viable skifield or access alternatives - e.g. development in the Doolan's Creek area and/or access over Coal Pit Saddle from Gibbston.

(3) Should the Land Settlement Board consider approving in principle the leasing of land for the proposal, the Commission recommends that before finalising any lease, and before any road construction commences, further investigations and planning as outlined in the audit (pages 16-19) be undertaken by the Company.

W. J. Wendelken
Acting Commissioner for the Environment

7 April 1976

APPENDIX A

Commission for the Environment

Birch House
53 Murphy Street, Wellington
Telephone ~~XXXX~~ 720.642

P.O. Box 12-042, Wellington North
New Zealand

LIST OF SUBMISSIONS RECEIVED

1. Ministry of Agriculture & Fisheries
2. New Zealand Forest Service
3. Department of Health
4. Department of Lands & Survey
5. Ministry of Works & Development
6. Department of Scientific & Industrial Research
7. Ministry of Transport
8. J.S.C. Begg and B. S. Jamieson
9. Boffa Jackman & Associates
10. R. W. Brown
11. Clare J. Carr
12. R.E.M. Carr
13. P. D. Chapman
14. Christchurch Tramping Club
15. G. W. Davidson
16. Ecology Action - Christchurch and Otago (2)
17. Mr R. Fantl & I. and E. K. Prior
18. Federated Farmers (Otago Provincial District)
19. Federated Mountain Clubs of New Zealand
20. Mrs S. Forster
21. Geological Society of New Zealand Inc.
22. Mr and Mrs G. H. Goldsbrough
23. W. Harris
24. D. G. Jardine
25. J. G. Jardine
26. J. D. and B. G. Knowles
27. F. and E. Lewis
28. S. L. McCurdy
29. B. J. Mason
30. John Middleditch
31. Marygold Miller
32. H. Miller
33. Nature Conservation Council
34. N.Z.D.A. (Otago Branch)

..2/

List of Submissions Received (continued)

35. New Zealand Scenery Preservation Society
36. N.Z.U.S.A.
37. Otago Catchment Board
38. Otago Tramping and Mountaineering Club
39. Mrs A.M. Smeaton
40. A.A. Snelder
41. Remarkables Protection Committee
42. Southland Tramping Club
43. Mr and Mrs A.N. Stead
44. Mrs M.J. Templeton
45. Treble Cone (Wanaka) Ski Fields Ltd
46. Tourist and Publicity Department (received: 24 March 1976)
47. Wakatipu Environmental Society

The following people wrote letters to the Commission which due to difficulty of reproduction have not been included in the published list of submissions however copies of these are available on request.

Miss L. Brierley
Beth Cullen
Mrs D.C. Dwyer
G.G. Fairfield
Mrs Joan Francis
Miss B.M. Goldsborough
Nan I. Green
Miss Rona McCurdy
E.C. Reid
K.P. Shannon
Vivian J. Whitehead
Ken & Margaret Wildman
Nancy Williams
Mrs Robin Winter
Mrs Mary Wynn
Mrs H.D. Young
Joan A. Kemp
Miss N. Ruth Oliver
Mrs Rhoberta Robinson

FREDERICK SHEPPARD AND PARTNERS

CONSULTING ENGINEERS

AUCKLAND
BOX 6543 TELEPHONE 360-464

WELLINGTON
BOX 12141 TELEPHONE ~~XXXXXX~~
725-581

CHRISTCHURCH
BOX 2632 TELEPHONE 50-468

F. J. SHEPPARD B.E., M.N.Z.I.E., M.I.C.E., A.M.I.E. (AUST.) AK
M. J. GRANT B.E., M.N.Z.I.E. AK
I. D. STEWART B.E., M.N.Z.I.E. WN

D. F. MACLENNAN B.E., M.N.Z.I.E. WN
D. M. STARK B.E., M.N.Z.I.E. AK

WELLINGTON

19 March 1976

Mr R.R. Forward,
Mount Cook and Southern Lakes Tourist Co. Ltd,
Private Bag,
CHRISTCHURCH.

Dear Sir,

REPORT ON CONSTRUCTION METHODS AND PROGRAMME
FOR PROPOSED RASTUS BURN ACCESS ROAD TO REMARKABLES SKI FIELD

On 11th March 1976, the following party walked the route down from "Big Rock" at 6 miles 10 chain to the level platform at 2 miles 60 chain, between 11.00 a.m. and 4.00 p.m.:-

Dr D. Bell	-	Geologist, University of Canterbury
Mr R. Forward	-	Mount Cook and Southern Lakes Tourist Co. Ltd
Mr R. Robinson	-	Mount Cook and Southern Lakes Tourist Co. Ltd
Mr R. Hughes	-	Earthmoving Contractor
Mr I. Stewart	-	Civil Engineer, Frederick Sheppard and Partners

Dr Bell's report of our joint survey on 11th March 1976 covers all engineering as well as the geological aspects discussed by us on site and it is not thought necessary to repeat them here.

A further short survey was made of the Section 2 miles 60 chain to 3 miles 40 chain by the same party without Dr Bell between 8.00 a.m. and 10.30 a.m. on 12th March 1976. A route was swung higher, going East, and it would be possible to turn back at the 3 mile 20 chain mark towards Trig G, turn East again and move above the slump area and then level more or less across to the rock slide area at 3 miles 50 chain. However, 150° to 180° turning anywhere on this particular North face is not recommended, and we can gain enough height by steepening the grade from 2 miles 50 chain to 3 miles 20 chain to pass a few chain below the head of the possible slumping area, commencing at approximately 3 miles 20 chain to 3 miles 40 chain and still level off on our approach to the rock slide area. Alternatively, if suitable sites to turn on can be found lower but at the right elevations we could follow this or a lower zig-zag route, but still go above the slump area and thus allow more freedom over higher sections further round the face;

but note this will increase the length of the road as seen by the public and to be maintained. This again emphasizes the need for much more survey work, as stated in the Environmental Impact Report.

The prime object of the surveys was to further refine the flagged route, taking the geological aspects into account as well as the engineering ones, and to later clarify and enlarge on various statements in the Environmental Impact Report.

The following general construction programme was mooted. Please note this programme has been under discussion and revision since January 1974, when our first engineering report on a 14'-0" access track to final grades was presented to the Mount Cook Company. (This was presented, unchanged, as Appendix "A" of the Environmental Impact Report).

(a) Programme

(i) Immediately the go-ahead is given for road construction I will spend several weeks in the field further defining the route, as has always been our intention, to avoid as much as is practically and reasonably possible unstable and steep ground. At a suitable stage early in the survey, and again when construction starts, we will engage Dr Bell to assess the geological aspects as discussed in his report.

Generally, the route will be varied, both as to grade (1:7 up to level or even down) and alignment to pick our way across the more difficult areas. One-way (say 14'-0" to 16'-0" wide formation widths) sections will be cut or filled as necessary to avoid major earthworks under difficult conditions, and when finally formed the two-way road or passing bays will be kept to a maximum of 25'-0" wide formation.

(ii) Upon approval of the finally flagged route, hourly rate hire of suitable machines will be called to work in conjunction with the Company's own machines, all under our general direction. This will allow maximum supervision and flexibility across difficult areas. A pilot track to minimum formation width will be cut ahead of the final formation work on proposed grade, culverts placed (to be extended later), and further investigational work carried out, including an engineering survey (long and cross-sections), soils testing, slope stability analysis, and geological soundings for base rock.

(iii) As this work is completed, the road, culverts, retaining walls and the like will be designed to take into account the results of our surveys, though there will be little change in culverting, alignment or grades. The survey and construction work will follow on progressively, the latter under the same contractual arrangements as for the pilot track, so that a minimum of delay results between formation of the track and completion of the final width, (both one and two-way), culverted and drained formation.

(iv) Approval of the bare formation, complete with culverts and side channels, will be obtained from the Catchment Board, Ministry of Works and Development, and the Lands and Survey Department at this stage and they will of course be kept informed of progress on the earlier stages of construction.

(v) Before final metalling (we may require minimum metal over short lengths of the road to obtain four-wheel-drive access) any improvements required will be made and approved.

(vi) During the September following the completion of the final full width formation, (iii) above, all cut and fill batters will be topdressed with fertilizer and seed to the Lands and Survey Department's requirements, all as covered in the Environmental Impact Report (Safeguards (i)).

(vii) Maintenance routines will be set up as covered in the Environmental Impact Report (Safeguards (ii)). In fact a quite specific maintenance programme should be written for this work, as we have done for about forty Broadcasting Council roads throughout the country. Tenders could be called for this work, but we understand you intend to carry out this work yourselves and will still require regular inspections and instructions from us, say, before and after winter each year, with special inspections if any problems arise.

The above programme should allow the maximum of flexibility in the short and the long term and hence protection of the environment, as well as limiting the rate of expenditure to a reasonable amount compatible with your aims and resources.

(b) General

I have made the following general notes in clarification of the Environmental Impact Report. I would however point out that most physical testing and investigations, other than walk-over surveys, such as investigational drilling, slope stability and soil studies, detailed topographical surveys and the like prior to approval for commencement of work would be very expensive and the considerable costs involved not recoverable, if for any reason the project does not proceed:-

(i) It is entirely possible from both the engineering and geological aspects to construct an access road up the Rastus Burn route in the region of that shown (general alignment only) on our drawing 7131-1/W3.

(ii) To reduce the impact upon the environment, it is proposed to limit the road formation width as necessary to one-way. We give below some of our present proposals to achieve that objective, but we require complete flexibility at this stage as to alignment, grade and formation width. These proposals, though perhaps not covered specifically in the Environmental Impact Report, have been dwelt on over the last 2½ years, during which a total of 8 full days have been spent in the field looking at improvements to the route; on each occasion several improvements were noted and/or flagged:-

(a) The route had already been considerably refined from that shown in Appendix "A", Drawing 7131-1/W3, before presentation of the Environmental Impact Report in December 1975, to get higher from the 2 miles 50 chains to give more flexibility in the approach across the main North facing slopes and to avoid large fill batters lower down and nearer Queenstown.

(b) The form of road we envisage is not of the type presently developed at Coronet Peak, i.e. long even grades on a straight alignment crossing the mountainside at formation widths of up to 50 feet in places.

The pilot road will be limited to 10'-0" to 12'-0" formation width and the alignment will "pick its way" across the Kawarau face, with careful variations in grade and line to avoid or limit cutting and filling. On the short lengths (maximum of 5 chains) through steep-sided gullies and ridges with side slopes greater than 2:1 (27°), we have long realized that properly compacted fill embankments will be hard to form and hence our proposal to have all the formation on cut for side slopes of greater than, say, 30°, though no hard and fast rules can be laid down here. We realize that the cut material on this degree of slope will spill downhill and be "lost", using conventional construction methods, but this will be limited by suitable methods such as benching, the proposed width reduction and careful supervision.

(c) We intend to use crib-walling, sheetpiling, driven railway irons and the like across the few faces where instability make the limitation of cut batters necessary. Over such sections the formation width will be limited to a maximum of 16'-0".

(d) All culverts will be 18" diameter or larger "Armco" galvanized corrugated steel and will be laid in gullies before any stage of the formation is constructed to maintain the natural watercourse slopes. This type of culvert is capable of extension by bolting on sections up or downhill to allow later widening of the formation. They also remain intact under longitudinal forces on steep slopes, unlike concrete pipes with rubber-ring spigot and socket joints. Refer (e) below for culverts not draining existing gullies.

(e) Through any unstable areas, or elsewhere as necessary, side channels at the base of the cut batter will be constructed in concrete and the water led downhill to culverts discharging on to more stable ground, thus possibly improving the present situation by good drainage.

(f) Later, when the ski-field is fully operational, the access road will be generally metalled to 20'-0" carriageway, but over all difficult sections with side slope greater than 30° being left one-way with 16'-0" formation and 10'-0" to 12'-0" metalled carriageway.

(g) By careful design and field supervision, sight distances can be maintained from each end of these one-way sections, or at least between short passing bays included at suitable spots.

(iii) There are no extensive lengths or areas of steep crossfall in the vicinity of the proposed route. The existing ledges can be used to great advantage to retain fill toes or sit the road on and we would steepen or flatten the grades to use these wherever possible, after having gained as much height in the lower, more stable country between 2 miles 50 chain to 3 miles 20 chain.

(iv) These particular slopes are at present well vegetated and should revegetate quickly at the lower altitude below 3,650 feet (altitude at 4 miles 70 chain) where the longer batters occur over the steeper side slopes.

(v) The mantle over bedrock on Coronet Peak appears to be much deeper and permanently wetter from my observations (it is on the South side and, being less steep, would tend to hold water in the solifluction lobes more). This leads to less stable cut and fill batter slopes than would be possible on the Rastus Burn Road. However, this will be the subject of a soils study.

(vi) It has been appreciated that there are wet and steep areas over the whole of the proposed route and that, mainly due to the latter, great care will need to be taken everywhere and especially when the two factors combine.

It is also a fact that the rainfall pattern (intense falls followed by dry periods), consistent mantle and the base rock (beds dipping 20° to the South) on the Kawarau face do not lead to general instability as compared with other areas in this country such as the area South of Taihape, volcanic ash and pumice areas around Rotorua and Taupo, the permanently wet silt and sandstone areas associated with coal mines on the West Coast of the South Island and other areas where either heavy rainfall, poorly consolidated or variable mantles and erratic bedrock combine to give deep instability.

Our firm's experience in this type of roading on steep, high, wet terrain over the last 10 years is unique in this country. During this time we have surveyed, called tenders, marked out, supervised, and continue to supervise, maintenance of some forty such roads of lengths varying from 30 chain to 7 - 8 miles long.

Again it must be emphasized in engineering and geological terms there appear to be no insurmountable problems with this road, and we have confirmed this with local contractors in this field of work, who know the area and the problems we are talking about.

Yours faithfully,

I.D. STEWART

IDS/EFW

APPENDIX C

RASTUS BURN ACCESS ROADING

TO

REMARKABLES SKI FIELD

PRELIMINARY ENGINEERING GEOLOGY REPORT

Written By: D.H. BELL,
Geology Department,
UNIVERSITY OF CANTERBURY

Date: 18 March 1976

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SYNOPSIS

1. SCOPE OF REPORT

This report discusses engineering geology aspects of access roading via the Rastus Burn to the proposed Remarkables Ski Field: Comment is based only on a preliminary on-site inspection of the route, and recommendations are made for further investigations.

2. SUMMARY AND CONCLUSIONS

2.1 Overall Feasibility of Route

From my preliminary inspection it appears probable that an alignment can be selected which will be satisfactory in terms of stability, environmental disturbance, safety and adequacy of traffic flow. However, this must be subject to confirmation by detailed engineering and geological surveys, and design and construction must be subjected to certain constraints which are enumerated below, and discussed elesewhere in the report.

2.2 Road Location and Design Considerations

Special attention must be paid to the following factors:-

1. Cut and fill construction
2. Batter stability
3. Active slumps and unstable areas
4. Road maintenance
5. Drainage and culverting
6. Environmental considerations (spillage during construction: revegetation: visual impact)
7. Pilot road construction
8. Flexibility of design
9. Construction safeguards

Many of these points are already under consideration by those involved with the project, but in my opinion particular care must be paid to minimising ground disturbance during construction, provision of adequate drainage, and revegetation of batters.

2.3 Problem Areas and Alignment

A final decision on road alignment must await further engineering and geological surveys. At this stage, the major problem areas are between 3m 20ch and 4m 00ch (recent slumps and block field), and from 4m 00ch to 4m 70ch (steep batters in solifluction materials). Elsewhere on the route, no serious geological problems have yet been identified.

2.4 Further Investigations

Additional geological surveys, including mapping of slope-forming deposits and determination of depth to bedrock by seismic methods, are considered necessary. These studies should be integrated with continuing engineering surveys to select optimum road alignment.

3. RECOMMENDATIONS

3.1 Road Width

I recommend that a minimum-width, one-lane road be constructed through most of the critical area from 3m 20ch to at least 4m 70ch, with passing bays where topographically and geologically feasible.

3.2 "Pilot" Road

I recommend that any "pilot" road be constructed to final alignment, grade and standard, with provision only for widening where feasible.

3.3 Further Surveys

I recommend further geological surveys be carried out in conjunction with continuing engineering studies to confirm route feasibility, and to delineate the optimum alignment.

REPORT

4. INTRODUCTION

At the request of Mr R. Forward, of The Mount Cook and Southern Lakes Tourist Company Ltd., a preliminary inspection was made on 11 March 1976 of possible access roading via the Rastus Burn to the proposed Remarkables Ski Field, near Queenstown. This inspection (in company with Mr Forward; Mr I.D. Stewart, consultant engineer to the Company; and others) involved both helicopter flights along a major part of the route, and a traverse by foot over what is understood to be the critical section, from approximately 3 miles 00 chains to 6 miles 10 chains.

This report discusses engineering geological aspects of the proposed roading access, in particular

1. the overall feasibility of such a road;
2. factors and areas requiring careful evaluation at the planning and design stages;
3. alternative alignments requiring further investigation; and
4. suggested methods of investigation to enable selection of the optimum route.

It must be stressed that this is only a preliminary report, and that further, detailed geological investigations are considered an essential pre-requisite to final route selection, design and construction: Such geological investigations should logically form part of the civil engineering studies for the project.

5. GEOLOGICAL SETTING OF REPORT AREA

The area under consideration (i.e. the proposed ski field at the northern end of the Remarkables, and the suggested road access via the Rastus Burn) is underlain by chlorite schists, which strike approximately east-west and dip to the south at 20-25°. The attitude of the schists is such that on the face above the Kawarau River bedrock should occur at relatively shallow depth (generally less than 5m), and in fact several outcrops of apparently in situ schist were located on the proposed road alignment during the preliminary inspection. Bedrock stability on this face will thus be largely controlled by joint orientation, in contrast to "dip slopes" on the schistosity where glacial oversteepening has initiated major mass movements elsewhere in the region (e.g. parts of the Kawarau Gorge). The fact that schists belonging to both chlorite subzones 3 and 4 are mapped in the area (Wood, 1962) is not felt to be of great significance, since the distinction between these types is based primarily on microscopic study, and the boundary is transitional.

Excavation of the Arrow Basin was caused by an ice tongue tributary to the main Wakatipu trunk glacier (which had its terminus near Kingston), with evidence for ice extending down the Kawarau Valley toward Cromwell during at least three separate glacial advances. Ice most recently occupied the Arrow Basin in the latter stages of the Last Glaciation (i.e. approximately 15,000 years ago), with glacial deposits (including distinctive rock types from the western side of the northern arm of Lake Wakatipu) present below Trig. G at approximate elevation 2900 feet asl: These deposits were presumably laid down during the last major glacial advance, although they may be somewhat older. In the Lake Alta area, cirque morainal deposits are mapped (Wood, 1962), and they may post-date the final retreat of ice from the Arrow Basin.

Slope development in the area under consideration is therefore a consequence of

1. glacial excavation (on the Kawarau "face") and deposition (on the Remarkables "face");
2. periglacial processes (with the formation of solifluction lobes and terracettes accompanying freeze-thaw breakdown of the schist bedrock);

3. mass movements (including rotational slides in periglacially-derived slope materials, and possibly translational sliding within bedrock);
4. natural erosion in watercourses, with both excavation and deposition of materials; and
5. post-glacial weathering of schist bedrock exposed as a result of the above processes (and producing a relatively thin soil mantle).

Large totara logs lying on the surface over much of the upper slopes (at least on the Kawarau "face") are presumably remnants of formerly extensive forest cover, which was destroyed by fire some 800-900 years ago (Wells, 1972): As these logs occur on areas in which relatively recent slump scarps are identifiable, as well as on adjacent ground which is apparently stable, it is inferred that there has not been extensive slope movement either initiated by or in the period since forest destruction (although this is not the case elsewhere in the Kawarau Valley).

6. RASTUS BURN ACCESS ROADING: GEOLOGICAL CONSIDERATIONS

6.1 Summary of Route Geology

The principal geological features along the route of the proposed road access via the Rastus Burn are summarised in Table 1 (page 8), particularly in relation to engineering considerations.

6.2 Road Location and Design Considerations

From preliminary inspection of possible alignments from approximately 3 miles 00 chains to 6 miles 10 chains, the following comments are considered relevant to final route selection and road design:-

1. Cut and Fill Construction: From considerations of side slopes, which are generally less than about 30° but locally steepen to greater than 40°, and of the nature of the slope-forming materials (and their likely geotechnical properties), any undue disturbance of the Kawarau "face" by excavation could initiate sheet erosion, and possibly slope failures (e.g. by rotational sliding in batter materials, or including sections of the road). I consider that the proposal to construct a two-lane, 30 feet formation width final access road would involve excessive disturbance of the face in certain, restricted areas, and therefore consideration must be given to construction of a final one-lane road (of approximate formation width 14 feet, or even less in places) through these critical sections, with two-lane passing bays and/or roading where topographically and geologically feasible. Subject to satisfactory results from further geological and engineering investigations, and to certain constraints on design and construction described below, such a road should prove satisfactory in terms of stability, environmental disturbance, safety, and adequacy of traffic flow.

2. Batter Stability: Stability of cut batters will be a function of the type of slope-forming material in which the excavation is made, and the following points are noted:-

   i. In fresh schist, stability will be controlled largely by joint orientation (since the schistosity dips into the ridge), and use should be made of steeply-dipping joint sets to gain stability, rather than a specific angle of cut.
   ii. In weathered schist overlain by a soil mantle, stability will be reduced, and design of batters may have to be varied during the construction stage to suit ground conditions encountered.
   iii. In the solifluction materials, a batter of $\frac{1}{2}$:1 (h:v) is unlikely to be stable, especially in high faces: Improved stability could probably be obtained by construction of a one-lane road with flatter batters, and also by reducing the ratio of cut to fill (placing the fill onto a prepared bench, and possibly using crib walling).

3. mass movements (including rotational slides in periglacially-derived slope materials, and possibly translational sliding within bedrock);
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   iii. In the solifluction materials, a batter of $\frac{1}{2}$:1 (h:v) is unlikely to be stable, especially in high faces: Improved stability could probably be obtained by construction of a one-lane road with flatter batters, and also by reducing the ratio of cut to fill (placing the fill onto a prepared bench, and possibly using crib walling).

iv. In glacial deposits (moraine, etc.) on the Remarkables "face", batters of $\frac{1}{2}$:1 will probably be stable, although dependent on material variation.

In summary, stable batter angles will vary in the slope-forming materials encountered on the route, with the solifluction deposits likely to give the greatest problems. Further evaluation of the geotechnical properties of the slope-forming materials is considered desirable before final roading design, although flexibility even at the construction stage will undoubtedly prove necessary.

3. Active Slumps and Unstable Areas: From the preliminary geological inspection a number of minor, active slumps and areas of active erosion of the thin colluvial mantle were identified close to possible road alignments: These will require further assessment and careful treatment during construction, since it will probably prove impossible to avoid all such areas. The need to prevent renewed instability and erosion on the Kawarau "face" is clear, and this must be a prime consideration in final route selection and road design.

4. Drainage and Culverting: In connection with drainage along the proposed route, the following points must be made:-

i. culverts of adequate diameter must be provided to allow for exceptional rainfall conditions;
ii. culverts should be of a design such that leakage beneath the road formation does not occur, since this could result in failure;
iii. intakes must be constructed such that blockage, leading to major scouring under heavy rainfall conditions, does not occur;
iv. provision of concrete water table aprons feeding the intakes may be locally necessary to prevent seepage beneath the road, etc.;
v. culvert outfalls will require special attention, and may involve piping into watercourses so as to minimise the possibility of scouring below the road level from concentrated water flows;
vi. spacing of culverts will have to be such that excessive volumes of runoff are not concentrated into small watercourses.

In summary, provision of adequate drainage for the road alignment is one of the most critical factors in maintaining stability, both of the road itself and of the surrounding country. Competent engineering advice is obviously necessary to enable practical implementation of the above suggestions.

5. Road Maintenance: Provision will have to be made both for clearing of snowdrifts, and for removal of debris which will fret onto the road as a consequence of freeze-thaw action on the cut batters. In addition, the need for regular inspection and maintenance of culverting, and particularly intakes, is stressed, a point already recognised in the proposals. The fact that the Kawarau "face" has a northerly aspect should mean that winter access problems will be minimised.

6. Environmental Considerations: The following points are made:-

i. During construction, it will not be possible to avoid spillage of material onto the slopes below the road alignment, and whilst this can be minimised by special construction practices and close supervision, some disturbance of the ground must be expected. There is no reason, however, why this should be any greater than for roads in similar areas, and in fact could undoubtedly be kept to an acceptable level, particularly if only a one-lane road is constructed in critical sections.

ii. It will be essential to revegetate the batters, and particularly the fill materials, as soon as is practicable after construction is completed, so as to minimise the potential for sheet erosion. No doubt specialist advice could be obtained on aspects of oversowing if required, but consideration might be given to regular topdressing of the

road alignment and the surrounding slopes to encourage vegetation growth and its attendant stabilising effects.

iii. Whether or not the road across the Kawarau "face" appears as a "thin line" from Arrowtown will depend on the degree of control which can be exercised over construction operations, and on the success and rapidity of revegetation. By constructing only a minimum width road where necessary, and with adequate attention to drainage, etc., there seems to be no reason why the Rastus Burn route should prove to be "visually unacceptable".

7. Pilot Road: The proposal to construct a "pilot road" to 14 feet formation width is noted, but in view of my earlier comments regarding possible stability problems, I would urge reconsideration of this approach. Any road which is constructed on the Kawarau "face" should be to final alignment, grade and standard, particularly with regard to culverting, since once erosion starts on such a face, it is extremely difficult and costly to stop, if not impossible. It may, however, prove feasible to widen sections of the road which are more favourably located, either to provide passing bays or sections of two-lane road, at various times after completion of the one-lane access road. To re-iterate my earlier comments, the need for a two-lane access road over the entire length must be reconsidered in view of the potential instability of parts of the route, whilst any road constructed should be to final standard and grade (although the extent of metalling of the surface at the outset could be minimal).

8. Flexibility of Design: At this stage of the investigations, final route selection cannot be made. It appears from a preliminary inspection that a suitable alignment will prove possible, but more detailed geological and engineering surveys are required to confirm this observation, and to identify the optimum route. From a geological point of view, I would suggest that a route be sought from 2m 50ch to the vicinity of Trig. G, thereby avoiding the major slump area between 3m 20ch and 3m 50ch and at the same time giving a reasonable grade and alignment to the problem area at about 4m 00ch. However, it is clear that further identification and investigation of problem areas is necessary, and hence that a flexible design approach must be maintained.

9. Road Construction: Once the optimum route has been selected, special care will still be required at the construction stage, both to avoid undue ground disturbance and to allow modification to design as a result of initial excavations. This obviously entails expert engineering advice and supervision, both in selection of equipment and during the construction operations. At this stage of the investigations, major geological problems are not anticipated during construction, but this may alter if and when design proceeds.

6.3 Problem Areas and Suggested Alignment

The major problem areas in road construction along the Rastus Burn route, as deduced from the preliminary inspection, are summarised in Table 1 (page 8). As indicated, principal concern is held for the sections from 3m 20ch to 4m 00ch, where at least two recent slump areas are to be traversed, and from 4m 00ch to 4m 70ch where locally steep ridges in solifluction materials will require relatively deep cuts. There do not appear to be serious geological problems over the remainder of the route, although it was not all traversed on foot: Further investigation of the steep wet gully (with underground seepage at 6m 10ch is considered necessary.

Whilst the route most recently surveyed by Mr Stewart from 3m 00ch to 4m 00ch appears feasible, I would suggest that the following alternative alignment be further investigated:-

i. from 2m 50ch to about 3m 20ch, an additional switchback be included to bring the road virtually onto the ridge crest at Trig. G;
ii. from 3m 20ch, the road to follow up the ridge crest to about 3000 feet asl, thereby passing above the probable head of the major slump; and
iii. from this point (about 3m 30ch) the road to approximately follow around the contour to meet the most recently surveyed route at about 3m 60ch.

This change to the suggested alignment would have the advantages of a. avoiding the recent slump area, b. giving greater flexibility and lower grades in the critical section to 4m 00ch, and c. avoiding major rock excavation to the north below Trig. G (about 3m 10ch). The main disadvantages could be in the steeper local grades to reach this elevation, and of course in the additional corners.

In the section from 4m 00ch to 4m 70ch, alternative alignments connecting isolated terraces appear possible, although further investigations are clearly required. In this section, a. road width will have to be minimised (both in cut and fill), and b. small, active slump areas will have to be further investigated and carefully treated. Construction in this area will pose practical difficulties in terms of ultimate road stability, and in preventing erosion and possible slumping of the slope-forming materials: Detailed engineering and geological investigations are necessary at the design stage, and close supervision at the the construction stage will also be essential.

Further surveys to select the optimum route from 4m 70ch to 7m 70ch are also necessary, although the existing flat areas at 4m 70ch and 6m 20ch (Big Rock) should be utilised for major corners.

6.4 Further Geological Investigations

In conjunction with further engineering surveys to decide final road alignment I would suggest that the following geological investigations be carried out, at least in the critical sections from 3m 20ch to 4m 70ch:-

1. Mapping and identification of geological deposits and features (such as slump areas) which may affcet ultimate stability, with mapping preferably at a minimum scale of 1:5000.
2. Evaluation of apparent stable angles in solifluction materials form field observation, supplemented by laboratory tests if considered necessary.
3. Incorporation of geological data onto raoding plans and sections, and including information on depth to bedrock obtained from seismic surveys.

As a preliminary estimate, field surveys over the critical sections could be expected to take at least one week. If the surveys were to be extended over the whole alignment, then a total of 3-4 weeks may be required.

6.5 Summary

The principal modifications suggested to the original proposals as outlined in the Environmental Impact Report are as follows:-

1. That a minimum width one-lane road be constructed through much of the route from 3m 20ch to at least 4m 70ch, and possibly to 6m 20ch and even beyond. This is to avoid undue disturbance of the slope-forming materials, and to minimise undesirable erosion and slope instability.
2. That any roading constructed be to final alignment, grade and standard, particularly with regard to culverting, although subsequent widening to provide passing bays or limited two-lane sections is not precluded where topographically and geologically feasible.
3. That further engineering and geological surveys be carried out to confirm the existence of a suitable alignment, and to delineate the optimum route.

It is stressed that a flexible approach must continue to be adopted in regard to the design and construction of access roading via the Rastus Burn: At the same time, an adequate and safe road with satisfactory stability and acceptable environmental disturbance appears feasible, providing certain constraints (particularly with regard to road width and drainage) are accepted in design and construction.

7. REFERENCES

7.1 WELLS, J.A. (1972) Ecology of Podocarpus hallii in Central Otago, N.Z. NZ Jl Bot, vol 10 no 3, pp 399-426

7.2 WOOD, B.L. (1962) Sheet 22 : Wakatipu NZGS 1:250,000 Geological Map Series

TABLE 1

RASTUS BURN ACCESS ROADING : SUMMARY OF ROUTE GEOLOGY

Chainage From	Chainage To	Slope-Forming Materials	Approximate Side Slopes	Comments
m 00 ch	2 m 50 ch	morainal deposits, with local post-glacial fan deposits and bedrock exposures (?)	20 - 25°	No major geological problems envisaged, but i. route selection to 1 m 40 ch yet to be made, and ii. adequate culverts and/or fords must be provided for stream crossings and surface drainage.
m 50 ch	3 m 20 ch	bedrock at shallow depth, with local glacial deposits	20 - 30°	Principal construction in bedrock, with joint-controlled stability: Possible one-lane sections to minimise batters and cuts
3 m 20 ch	3 m 50 ch	probable recent slump with head at 3000 ft asl (±), and totara logs on surface: Depth to bedrock probably 1-5 m	25 - 35°	Not clear whether slump presently active, but major excavation could cause problems: One-lane road recommended, but preferable to pass above slump head if possible.
3 m 50 ch	4 m 00 ch	evidence of some recent slumping, but totara logs on surface: Large schist blocks on surface, and 100 m wide "boulder field" (with fines removed): Bedrock depth uncertain, probably 0 - 5 m (+)	30 - 35°	Difficult zone, requiring careful design and construction of one-lane road: Further investigations necessary for optimum route selection: Stability largely derived from boulder interlock, and minimum disturbance therefore essential.
m 00 ch	4 m 70 ch	periglacial slope deposits and local slumps: Depth to bedrock uncertain, but probable outcrops noted	30 - 40° (+)	Alternative alignments connecting terraces possible, but further investigations necessary: One-lane road with passing bays suggested, with special attention to slump areas: Minimal cuts in steeper side slopes with possible filling onto lower benches, and use of crib walling.
+ m 70 ch	6 m 20 ch	periglacial slope deposits, with occasional bedrock exposures	25 - 35°	No major construction problems envisaged, but i. wet gully at 6 m 10 ch requires further investigation, and ii. use of one-lane road in steeper side slopes.
6 m 20 ch	7 m 70 ch	periglacial slope deposits, but depth to bedrock uncertain	Not inspected on foot, but no obvious problems: Further investigation necessary to select optimum route.	

APPENDIX D

D.S.I.R., New Zealand Geological Survey, Report on Sections of Proposed Access Road.

nb: Figures 2,4-9 consist of photographs which it was not possible to reproduce.

RECEIVED
30 MAR 1976
by

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH

APPENDIX D

New Zealand Geological Survey

P.O. Box 5342,
DUNEDIN

25 March 1976

The Commissioner for the Environment,
P.O. Box 12042,
WELLINGTON NORTH

Attention: Mr M. Holm

Dear Mr Holm,

REMARKABLES SKI FIELD ENVIRONMENTAL IMPACT REPORT
Proposed Access Road

In answer to your letter of 9 March, I will limit my comments to that part of the road proposal between 2 miles 50 ch. and 6 miles 30 ch.- just beyond "Big Rock". I walked over this section on 6 March.

NATURE OF SLOPE

Only short sections of the road route are in "in situ" schist, and in a few favourable places a batter may stand as steep as ½ to 1 in bedrock. However, this would be the exception rather than the rule. The Southward dip of the schistosity into the hill is more favourable than a north dipping schistosity, but the jointing perpendicular to the schistosity weakens the rock in such a way that rock masses readily break off under gravity. The bedrock will be to some degree stressed and incoherent so that it does not hold together readily across joints. There is a similar situation above the main highway at Nevis Bluff, where jointed schist dipping into the Bluff stood in a face at an angle of 60° (less than ½ to 1) before the last major rock fall occurred. Most of this section of the route is on a slope deposit of fine grey silty sand with angular schist particles in sizes between 2mm and 20cm and many very much larger blocks. The topography is well described in Mr Cookson's report (part of MWD submission) par. 2. I did not see fissuring along the lobe margins, but there are fresh scarps and cross-slope cracks above the road route in one area near 4m 10ch. point. The landslide material forms a hummocky topography with slopes up to 40° or more on the down slope side of the hummocks. A landrover road could avoid some of the steeper slopes by constant changes of grade and by including very steep sections not suitable for a car road.

PROPOSED BATTER ANGLES

Several small slump scarps were investigated in this landslide material, and the surfaces of these scarps were found to be standing at angles between 36° and 45°. This is the best indication we have so far of batter angles required to produce some sort of stability in

(continued)

road cuts. A 45° batter would be an optimistic design and would probably need a lot of maintenance. This would produce a very high cut in side slopes of 40° that could generate large landslides. A road batter south of the Crown Range Summit at about the same altitude and cut in very much the same material is shown in Fig. 2. The cut is standing at an angle of 47° and evidently requires constant maintenance to keep the water table clear. The tussock covered slope (37°) above the batter is stable and not part of a recently active landslide as on the Remarkables face.

DETAILS OF SECTIONS OF ROUTE

Fig. 3 (map) is traced from aerial photos and is not on a uniform scale. Mileage figures have been transposed from plan 7131-1/W3 in the E.I.R. by matching the topography.

2m. 50ch. to 3m. 30ch. I agree with the statement in the MWD report headed "Access Road" by Mr P.M. Gallant. A landrover track is feasible, a 30ft wide road would need steady maintenance, and if bulldozers were used to form the road on this section part of the spoil would move far down the slope increasing visual impact.

3m. 30ch. to about 3m. 70 ch. This is steeper than the previous section with increasing slope stability problems.

3m. 70ch. to cairn on ridge near 4m.10ch. This is a most difficult section. The half mile length crosses slide debris from an active scarp shown in Fig 3 and parts of the slope are over 40°. Large boulders fallen from the slope above litter the first quarter mile. See Fig. 4. (4m. 40ch. in the EIR Appendix A par. 4 may be an error). The first water seepage seen was in the centre of this section, and as our inspection was in a very dry period we can expect much more surface water flow during more normal rainfall periods. I find it very difficult to visualise a 30ft road over this section. A stable batter angle would be no more than the existing slope over part of the section. Cuts would be bound to start landslides, and these could develop into large slope failures especially during heavy rain. Special design (e.g. one way road, batter support, building road on rock fill to avoid cuts, careful management of drainage) would be essential and problems still may not be avoidable.

4m. 10ch.to first hairpin bend at 4m. 70ch. This section is not threatened in the same way as the previous section by active scarps up slope, but the route is still in slide debris with some very steep slopes over short sections where a stable batter angle of less than 45° would not be possible without much scarring of the slope. Major slope failures are possible, and a small landslide on the line of the proposed road (Fig. 5) indicates marginal stability.

4m. 70ch. to 5m. 20ch. (First leg of zig-zag). This was recognised in the E.I.R. as a difficult section. It is hard to imagine a 30ft wide road up this face without massive cuts and fill and much scarring of the face. This and neighbouring sections of the road would be clearly visible from the Crown Range Road (Fig. 6) and could well be one of the first things to catch the eye at the Crown Range Summit lookout. Aerial photos (e.g. Survey 884 run C. No. 11) and also Fig. 3 and Fig. 7 from "Big Rock" show extensive landsliding North-east and South of the bend at 4m. 70ch. There is a small landslide part way along this section, again demonstrating marginal stability.

(continued)

5m. 20ch. to 6m. 00ch (Big Rock). The upper half of this section is across an east facing slope covered with heavy tussock and with wet peat zones. Slopes are in places over 35° . This is in the upper part of a zone of landslide debris that extends down to the Rastus Burn. Water was flowing in a water course crossed just north of Big Rock, one of the few surface flows seen. There could be stability problems here due to low shear strength of the wet peaty slope deposit, the breaking of the tussock cover and disturbance of the natural water flow. It might be advisable to review the proposal for a further zig-zag on this part of the slope (drawing 7131-1/W3).

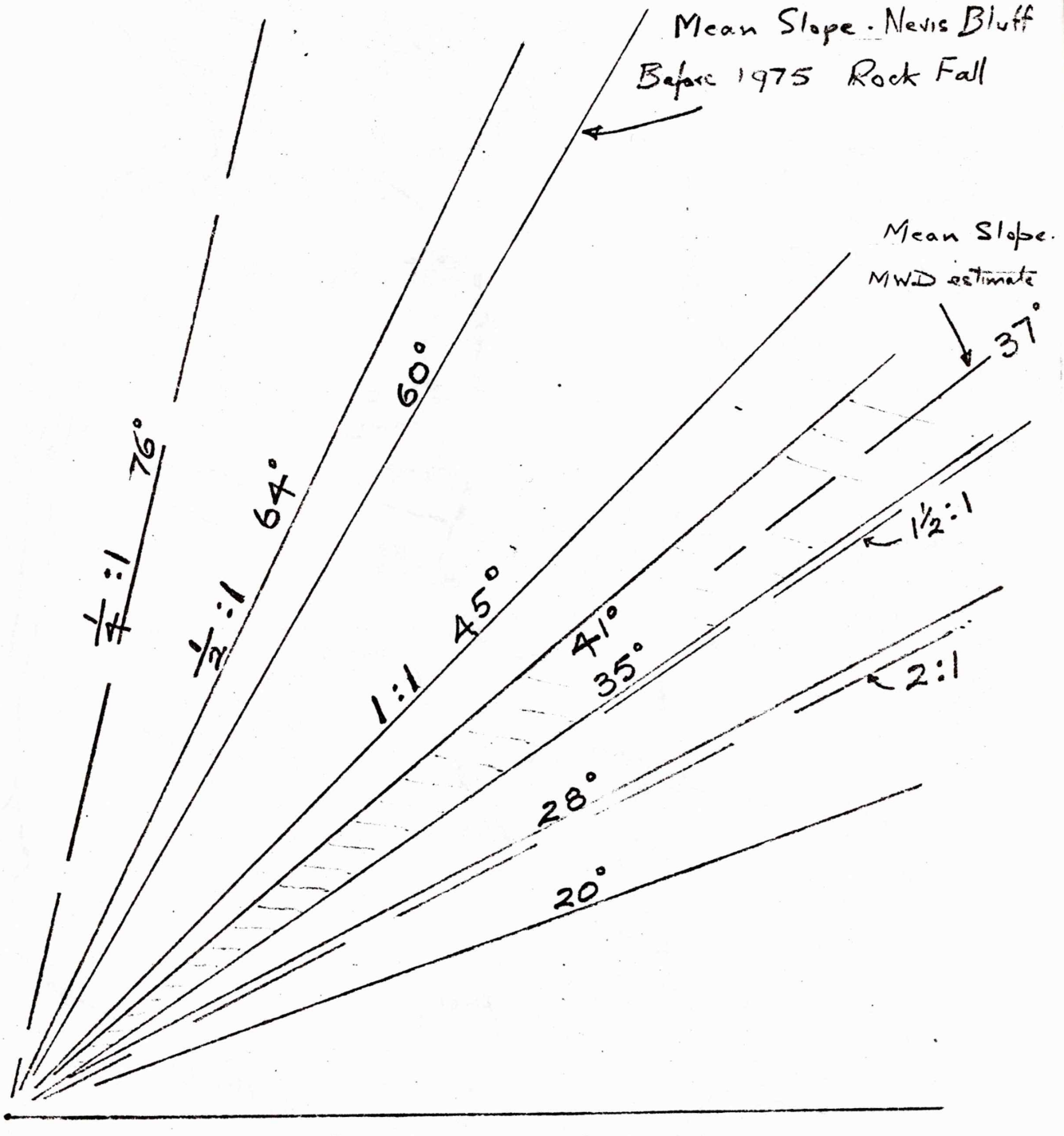
THE DISTANT VIEW

I consider the visual impact is underestimated in the EIR. There would be little difficulty in seeing a landrover road from Arrowtown, and high batters and new landslides would be very conspicuous. It is quite easy to see the landrover road on the ridge crest above Crown Saddle from the Kawarau face of the Remarkables, and as stated previously the zig-zag between the 4m. and 6m. peg would be prominent from the Crown Range road.

Yours faithfully,

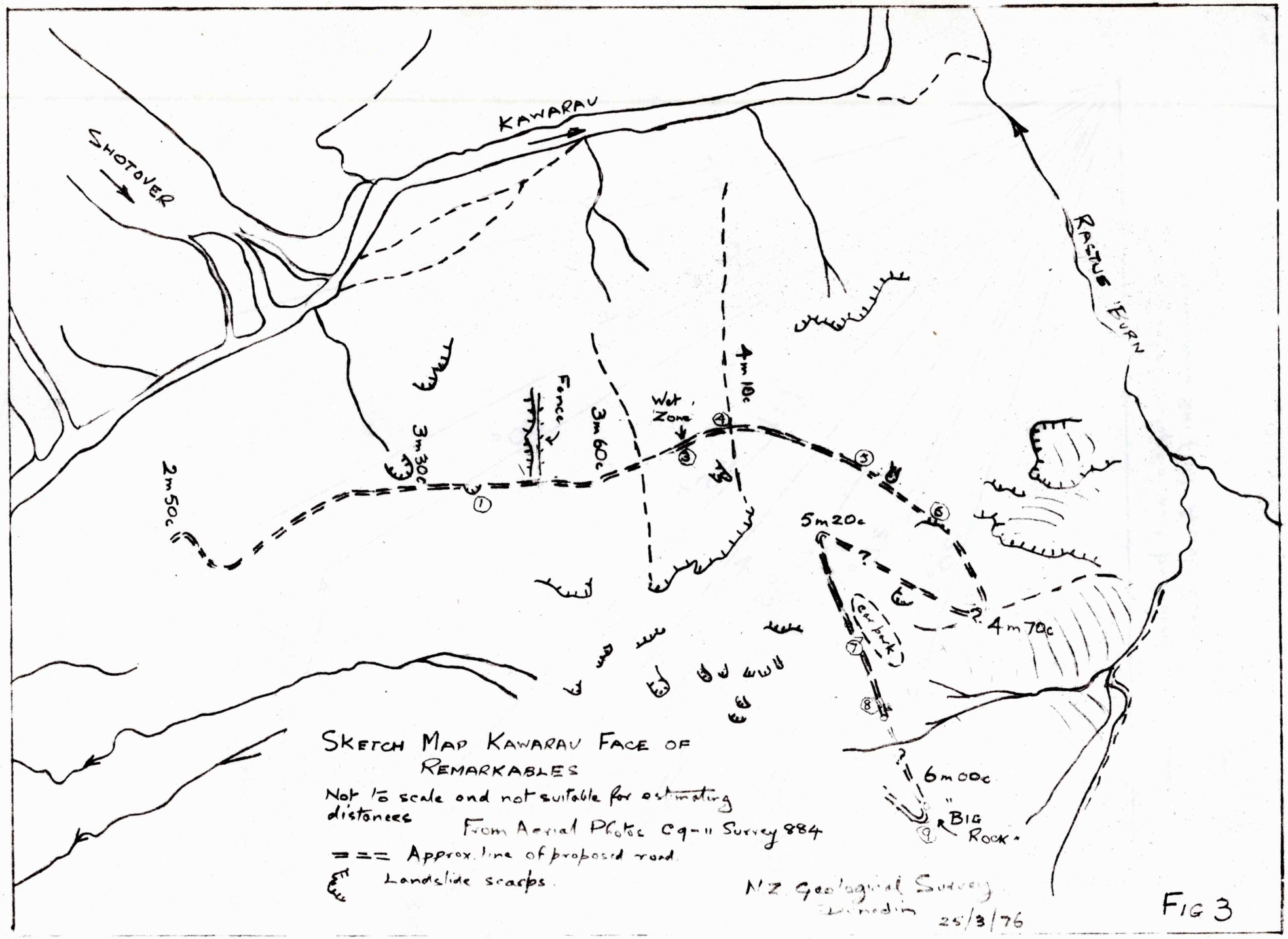
Ian C McKellar

(Ian C. McKellar)
District Geologist



Some Surface slopes and proposed Gutter angles.
Remarkables Ski field Access Road.

FIG 1



SKETCH MAP KAWARAU FACE OF REMARKABLES

Not to scale and not suitable for ~~estimating~~ distances

From Aerial Photos Cq-11 Survey 884

=== Approx. line of proposed road.

Landslide scarps.

NZ Geological Survey
Dunedin
25/3/76

FIG 3